AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 11, Vol. VII. New Series.] DECEMBER 1, 1841. [Whole No. 395. Vol. XIII.

[For the American Railroad Journal and Mechanics' Magazine.]

LONG ISLAND RAILROAD.

"*This is essentially a farmers railroad; by them it should be supported, and for their interest it should be directed,*"—ED. RAILROAD JOURNAL.

It would be no uninstructive occupation to the citizens of our goodly city of New York to look into the past history and present condition of the approaches to it by railway, now about receiving its deserts from the public, in the acknowledgement, that over all other modes of improvement, it is the *most conducive* to prosperity.

In casting the eye around then, we have in the fragments that remain, evidence that the attempt was at least made at an early day, to render our city, by this speedy process, accessible at all seasons, to and from the four cardinal points.

Let it be, as in truth it was, more owing to the misfortunes pecuniary and moral, of the times—and of necessity, that three of these attempts were abandoned and left for so long a time to their fate, and it is now to be viewed as matter of congratulation, that we have at all and in any how been again enabled to resume work upon them, which we receive as the earnest of more enlightened views in regard to this improvement, and of the intention to prosecute them with vigor to completion.

These avenues may be thus reviewed:

To the South.—Completed for some years, but in a very bungled

manner, the immediate 87 miles not being run over in less than 7 hours, in the average, while it ought to be done in 4½ and 5 hours, the nominal fare for that distance being 4¾ cents per mile, while by this loss of time, the real cost is at least 10 cents—this is the more important, as this line forms the *clasp* to the chain connecting nearly our whole Atlantic coast.

To the North.—Has been completed as far as Fordham, 12 miles from New York, and is now being continued to White Plains in the county of Westchester, and is to go ultimately to Somers on the confines of that county, by the company styled, the New York and Harlem railroad company. From Somers it is to be continued to Albany and Troy, a great focal point, by a separate company, some time since organized, but which has been unable to operate, owing to the peculiar position in which it is placed as to connecting on fair terms with the Harlem company.

To the West.—Has been completed as far as Goshen in the county of Orange 68 miles from New York, and has been for some months in successful operation; the remaining 400 miles terminating at Dunkirk on lake Erie, is in rapid progress—a large portion has been already graded in different sections and 3½ millions of dollars on the whole expended. It is calculated to finish the entire line in about three years.

To the East.—Has been completed from Brooklyn to Hicksville on Long Island 27 miles, and is now being continued 20 miles further, terminating in the neighborhood of Smithtown, Islip, and Patchogue, leaving 48 miles to take it to its terminus at Greenport, 95 miles from Brooklyn ferry.

The perusal of a report of the 1st February, 1841, from the directors of the Long Island railroad company to its stockholders, induced us to a personal visit along the line of the road and of their renewed operations, and called up the above lines in review before us, as well as led us into a fuller consideration of this eastern approach, the important points about which, we find really worth being brought to the notice of our readers.

And first, as to the actual financial condition of this concern:

The amount expended on the Brooklyn and Jamaica railroad, 11 miles, - - - -	$370,000	
The amount expended on the Long Island railroad to Hicksville 16 miles. - - - -	773,000	
Amount carried forward		1,143,000

Amount brought forward		$1,143,000
The amount required to complete the road to Greenport 68 miles, it is found by *actual contract* will not exceed $6,000 per mile,	408,000	
		1,551,000
Locomotives, freight and passenger cars and ferry boats, -		149,000
Cost of the whole line equipped equal to about $18,000 per mile,		$1,700,000

Thus it is seen, that if the road is carried through to Greenport, that even after throwing in the heavy cost of the first short sections, a most moderate average cost per mile, is still obtained for the whole line, owing to the very cheap rate at which the last and long section can now be contracted for. It is therefore of the highest consequence to the holders of the first large issue of scrip, now nearly worthless, ($3¼ per share,) of understanding well the facts in this case, which ought to satisfy them, that the opportunity is before them, by united action, to bring the whole up to par, and under the influence of such temptation, we trust the opportunity will not be lost, by at once making this road the great eastern outlet to our city, as it naturally is, by the greater facilities it offers, and which require only to be *properly applied.*

And secondly.—The road being thus completed, it is well to look first, at the certain *fixed sum* which it must earn to pay the interest on the outlay, and the expenses of repair and management. This may be stated as follows:

Interest on $1,700,000 capital at 7 per cent		$119,000
Repairs and renewal of rail, an appropriation per annum, of - - -	6,000	
Repairs and renewal of wooden structures, an appropriation per annum, of, -	5,000	
Adjustment and charges extraordinary, for ferries, etc., an appropriation per annum, of, - - - - - -	10,000	
Management, salaries, etc., etc. -	9,000	
	30,000	
		$149,000

and which it *must earn at any rate.* It remains therefore to show what are its resources for so doing.

And thirdly, as to those resources.—The business and travel on

this line are fortunately no longer conjectural, but are matters of record. It is, however, unusually beset by competition, there being no less than seven other avenues to reach the same point, one of which only, is of any real moment to this line, and that is by the steamboats running parallel to it on the sound. If we assume, therefore, that the boats could not afford to run to Stonington at less than $2 per head, that rate could be safely taken as ensuring a majority of travel to the railway, performing the distance in half the time and with less risk, but in order to make assurance doubly sure, it may be most prudent for an estimate to put the fare at $1¾ per head for delivering the *passenger and his luggage* at the depot at Stonington or at $1½ deliverable at Greenport, giving him the advantage of the competition of the Norwich line to Boston against that from Stonington. In this manner will the lowest possible fares be secured throughout, which in no case here, can be matter of option, but must be that of the cheapest rate with the best *accommodation and most despatch.* To give full effect to this line it is scarcely necessary to say, that its arrangements must assimilate to that opposite to it and leading south from Jersey City. The passenger being booked and his luggage crated on this side of the water, leaving him only to care for his safe transfer from one conveyance to the other, and but to look after his umbrella clear through to Boston.

From data furnished by the lines which have for some years been in operation in this direction it may be assumed that the through travel to Boston is not now short of 105,000 annually, of these we will say that three quarters or 75,000 pass over the Long Island railroad at $1¾ landed at the depot at Stonington, $131,250

The way travel for the whole line is more difficult to come at, for 27 miles it now averages per annum, almost $40,000, say that it will double itself as a moderate calculation, -	80,000	
	$211,250	
Cost of transportation, say 25 per cent as per experience on other and less favorable roads	51,250	
		$160,000
Freight through to Stonington, and express packages, etc. - - - - -	35,000	
Way freight being now $20,000 for 27 miles, may be put at double for the whole line -	40,000	
Amount carried forward	$75,000	$160,000

Amount brought forward	$75,000	$160,000
Cost of transportation, say 30 per cent, agreeable to experience on other and less favorable roads - - - - - - - - -	23,000	
		52,000
Mail carried, say 120 miles from *New York to Stonington* - - - - - -		25,000
		$237,000
Deduct repairs and management as above, being a full allowance - - - - - -	30,000	
Interest on $270,000 at 7 per cent, as stipulated to be allowed to the Brooklyn and Jamaica railroad - - - - - - -	26,000	
		56,000
		$181,000

being equal to $13\frac{66}{100}$ per cent on a capital of $1,330,000.

This exhibit, therefore, based as it is, on ascertained results, makes it entirely certain that 8 per cent at least, will be yielded on the full value of this stock, and if we allow for the reduced fare and better accommodation here contemplated, it must be admitted that the scale of business above assumed for it will be at least maintained, if it be not exceeded by the actual result.

It remains only for us to add a word as regards the character of this road—it comes fully into the category of those "judiciously constructed between desirable points"—it has indeed, three important features peculiar to itself, one, that of being in *nearly a perfectly straight line*, another, that of not being *disfigured by a single bridge*, and another, that of *laying on a gravel bed throughout its whole line*, in which it will be more likely to petrify than to rot. These advantages united to a solid structure generally, the rail being 57 lbs. per yard, with very light grades, will ensure the transportation being done over it whether light or heavy, at the cheapest cost, and will keep down its general expenses at the veriest minimum rate.

We are advocates of personal inspection, and we say, therefore, go ride over this road and draw your own conclusions. You will there find in Mr. Shipman, the engineer of this road, not only the willingness but the ability, to give you every necessary information.

[For the American Railroad Journal and Mechanics' Magazine.]

STEAMBOAT NAVIGATION.

"The advantages that have followed this discovery are too great to be calculated."

Such are the concluding words of a notice of the first essay between New York and Albany, made by *Robert Fulton* in 1808, with the Clermont steamboat, the particulars of which are given in the October number of this Journal.

Every body must have heard of the "Fulton claim," of which we may here give a summary. It is not altogether one which can be made out *exactly* in dollars and cents, but requires in estimating it that expansion of the mind and swell of the soul which accompany the contemplation of the *glory* of one's country, and which lies so emphatically in her GREAT MEN.

1st. In 1814, the only steamboat in New Orleans, about the time of the attack on it by the British, was the Vesuvius, she belonged to Mr. Fulton, but was appropriated by the Government to their own uses, and the opportunity of immense profits during that period of alarm was taken from him.

2d. For his time given in various experiments during the war, in submarine defensive operations against the British fleet on the coast. It is well known that the terror of Fulton's name, who had given the English admiralty a specimen of his torpedo, and which they would have bribed him to suppress, kept the British vessels out of our waters, and when they chanced to catch a prisoner off the coast, the first inquiry always was, "*Where is Fulton?*"

3d. For his time and services in building the Government steam frigate Fulton, in that day of inexperience, a most arduous duty, compared to a later period, when the Greek Government paid our mechanics most liberally for their skill in ordinary ship building, and very recently when the Spanish and Russian Governments have paid our mechanics the compliment of employing them in building steam frigates at a very handsome remuneration.

4th. In the use of his patent, by which the whole nation has been advanced in the last twenty-five years in numbers, wealth and innumerable comforts, which, without his discovery, it would have taken them centuries to have reached.

It was some time before this claim could be embodied in any shape proper for the consideration of Congress, until it was taken up by Mr. Whittlesey, so long the stern and indefatigable chairman of the Committee of Claims, and by his disinterested exertions was such data placed before Mr. Dickerson, then Secretary of the Navy,

and to whom Congress had referred it for appraisement, as enabled him to report to be due to Mr. Fulton's heirs a balance of $100,000 arising in the four items above enumerated.

To show the *noble feeling* of one branch of Congress on its first reference to them, we give the report of the debate which ensued on the bill being brought before them, and which then passed by a majority of thirty-six. It did not reach the Senate until the *last hour* of the following session of 1841, when by the absence of its friends it was lost by a majority of four, but the *reconsideration* of the vote was subsequently asked for by the Honorable John Davis, Senator from Massachusetts.

In renewing it now, the claimants will have the *additional ground* of the extensive use to which the Government are about applying this invention in naval defence, and as its very terrors are enough to keep off foreign aggression,—the consequent saving to the nation in outlay of preparation, and the escape from the destruction which would follow attack, makes the item awarded in this case to the heirs of this great benefactor of his country and the world, but *a fraction* in the comparison.

"Mr. Owens, of Georgia, called for the reading of the report of the Secretary of the Navy on the case, which was read accordingly.

"An animated debate now arose, which occupied the House during the remainder of its sitting.

"The bill was opposed by Messrs. Owens, McKay, Craig and Russell, and advocated by Messrs. Wise, Whittlesey, Hoffman, Legare and Biddle; when

"Mr. Duncan, after expressing a desire for further information relative to the case, moved to postpone the further consideration of the bill to the first Friday in March next; but the motion was negatived without a count.

"Mr. Petriken moved an adjournment; this motion was promptly negatived.

"Mr. Russell moved to amend the bill by striking out 'one hundred' before 'thousand dollars,' (referring to the sum to be paid to Fulton's heirs,) and inserting 'twenty-five,' but subsequently modified the motion so as to leave the sum in blank.

"On this motion he demanded the yeas and nays, which being taken resulted as follows: yeas 80, nays 111.

"So the motion to *strike out* was rejected.

"Mr. Haynes then moved to strike out 'one hundred' and insert 'fifty.'

"Mr. Wise demanded the previous question.

"The House sustained the call: ayes 91, noes 72.

"The previous question was then put and carried; and the main question, on ordering the bill to its third reading, was decided by yeas and nays in the affirmative.

"So the bill was ordered to be engrossed for its third reading; it was then (after an unsuccessful motion for a call of the House) read a third time, passed, and sent to the Senate for concurrence.

"[The debate on this bill was highly interesting. The opposition to it was placed mainly on the ground that in making up Mr. Fulton's account with the Government, the Secretary of the Navy had made by far too large an allowance for his personal services, and also for the use, by the Government, of his steamboat Vesuvius, during the attack on New Orleans, where she was impressed for the conveyance of troops, and was run aground while thus employed, and remained useless for three months of that busy period. The opposition of Mr. Russell was determined and persevering, and accompanied, occasionally, by remarks not highly complimentary to the merits of the illustrious dead.

"The defence of the bill was warm, resolute, and at times very eloquent. The merits of Fulton,—the debt of gratitude due him from the whole American people, and the national reproach arising from the destitute situation of his orphan children, were dwelt upon with great effect, especially by Mr. Hoffman and Mr. Legare; *while Mr. Whittlesey advocated the claim in the most spirited manner, as matter of right, on the documentary evidence submitted to the Committee of Claims.*]"

JOBBING ON RAILWAYS.

We extract the following from the English Railway Magazine, as furnishing a useful hint in all future railway or canal schemes, or any public improvement whatever:

"*Jobbing of directors.*—Our readers will remember that some time ago we hinted that jobbing was going on in some companies, that in fact there were directors, who, unmindful of their duty to their constituents did not keep their hands quite clean of the contracts.

"There are, probably, some who believe that the dealing in, or supplying of articles for the railway, is not improper conduct, provided it be done in the honest and straight forward way of business, and without taking advantage of their situation to exclude others, to get larger prices or larger profits by furnishing inferior articles.

They think the sole object of the act preventing directors from taking contracts was confined to this, and that it was not intended to exclude fair and honest trading transactions. We have no doubt such in effect was the object of the legislature, but knowing from the experience of six thousand years, that all the sons of Eve partook of that primitive lady's weakness in resisting temptation, and her propensity to taste of forbidden fruit, the Parliament has wisely commanded that all temptation, and even the possibility of it, be removed from railway directors, in order that their virtue may not be assailed.

"Hence all acts of Parliament contain the following clause:

"'Provided, nevertheless, and be it enacted, That if any director secretary, clerk, treasurer, or other officer, or servant of the said company, shall, either directly or indirectly, be concerned in any contract with the said company, etc., etc., every such director shall thenceforth be disqualified from voting or acting at any succeeding meeting of directors, and his office shall thereupon immediately become vacant, and every such clerk, secretary, or servant of the said company shall, thereupon, be immediately discharged from the service or employ of said company,'" etc., etc.

It is no excuse, although some palliation, that in these matters of tergiversation they are nearly as bad abroad as we are here at home. It is now time to be a little more restrictive than it has, however, been our custom, and no company of any moment, which has run its career in the last ten years, but should have a thorough overhauling as to its past doings, present condition, and future prospects. It has been most fully shown, of late, that corporate immaculacy is scarce indeed.

[From the Railway Magazine.]

PRESENT STATE OF THE QUESTION OF LOW FARES.

The subject of fares is one, which, with the extension of railways for traffic, must necessarily attract much attention, and it is evident that it now attracts a great deal. Like all other questions, it has two sides and two parties, one, which we may call the passive party, that which holds that the higher the fares the greater the profit, and the other, which is an active party, which advocates low fares as the only genuine source of healthy traffic and steady profit. For this latter cause we have long labored, both in the former series of the *Magazine*, and in the present, and we believe that we may claim the merit of having been the first and most persevering advocates of this great principle. To us, therefore, to contemplate the present state and prospects of the parties contending for low fares, must be most agreeable, and we know no period more fitting than this,

when the yearly meetings of most of the companies have been held. It will be found from this investigation, that the principle of low fares is no longer dependent upon the pen or upon theory, advocated only in the closet by a few, but that it is daily making way, and coming into practical operation among a large number of the railway companies. It is evident that the sticklers for high prices are alarmed, and although Mr. Chaplin and its other partisans, may thunder forth from the chair diatribes against writers and theorists, he and they will find that the rapid progress of the other system already prognosticates the ultimate result. The following, among other companies, have now declared themselves in favor of low fares:

The Manchester and Leeds.
The Glasgow and Ayr.
The Glasgow and Greenock.
The Croydon.
The Blackwall.
The Dundee and Arbroath.
The Arbroath and Forfar.
The Dublin and Kingstown.
The Chester and Birkenhead.
The Hull and Selby.
The Stockton and Darlington.

The following have affirmed the principle of third class carriages at low fares:

The Great North of England.
The Greenwich.
The Newcastle and North Shields.
The Eastern Counties.
The Birmingham and Gloucester.

We shall now proceed to give some of the testimonies to low fares, furnished by this years proceedings from the present volume of the *Magazine*. The Newcastle and North Shields directors state (p. 98,) that "they had advanced the second class fares, and given increased accommodation, at the same time they added a third class of open carriages at a lower price." The Grand Junction (p. 121) announce "a further reduction in the rates for the carriage for goods has been made since the last general meeting; the result of which, has been an increase in the quantity, as well as in the money receipt from this source. The directors have been guided by a conviction that the undertaking would be promoted by the increase of traffic created by such inducements." The Greenwich directors (p. 139,) confess that they have been obliged to introduce third class carriages, "rather in deference to the wishes of many of the shareholders, and to the practice of other railways, than from convictions of their own." At that meeting they seemed rather disposed to throw them up, but in July they say, (p. 600,) "some experience has been afforded by the use of these lower priced carriages for the last twelve months, by which it would appear to be imperative, from the existing competition, that they should be continued." They

further recommend the abolition of 2nd class fares, and reduction of 1st class fares. The directors of the eastern counties (p. 187,) say, "that they have been for some time in negociatiin with the Thames Haven company, and the Harwich and Colchester branch, to decrease the toll." At the North Midland meeting, (p. 195,) the chairman stated that the board were prepared to entertain the question of a reduction in the Manchester and Leeds toll, as a matter only of revenue, but as matter of principle, there were some doubts. By the Manchester and Leeds directors, who honorably lead the way in maintaining the great principle, it is avowed (p. 237,) that the company have adopted this "principle of carrying a larger number at low fares in preference to a smaller number at high fares." In March, the Croydon directors announced (p. 239,) that "they adhered to the opinion expressed in their late report, that increased facilities and reduction of fares are the means most likely to lead to a remunerating revenue." Again, in September, they say, (p. 775,) that "they are firmly convinced that lower fares would so greatly increase the number of passengers as to add to the income of both companies, (the Greenwich and Croydon.") The Dublin and Kingstown directors (p. 299,) express their satisfaction with the result of the late reduction in the second class fares, and in the rates of subscription, and with the plan of family tickets. They also intimate an intention of giving greater facilities. Notwithstanding an increase of a quarter of a million of passengers, or twenty per cent., the expences of the locomotive and carriage departments, were £772 less on the year. The Chester and Birkenhead board report, (p. 339,) that the charges had been reduced, and the traffic has since steadily and progressively increased. The directors of the Hull and Selby, state (p. 688,) that they have consented to grant monthly tickets to parties residing on the line of railway, allowing them to pass as often as they think proper, on the payment of one fare daily. The Glasgow and Greenock board announce (p. 581,) that their fares are unusually low, and that the result already confirms the soundness of their views. The Glasgow and Ayr directors advocate (p. 788,) a reduction in the fares of the joint lines. The report of the Blackwall directors states (p. 715) that, "although the present fares are unquestionably low, (perhaps lower than any other railway in England,) the directors would deprecate any increase, until the present rates have had a fair trial, with the advantages of the extension line." The Great North of England directors state (p. 799,) that "third class carriages have been attached to some of the trains, and the scale of fares fixed so as to enable all classes, according to their means, to avail themselves of the railway." The Ulster directors announce (p. 802,) that "they are anxious to settle rates of fare on as moderate a scale as possible."

Another proof of the interest taken in the debates which have taken place at several of the meetings:—At the Manchester and Leeds (p. 239) a long and interesting debate took place on fares, and even in that liberal company a motion was brought forward to give some additional accommodation to passengers. At the Dublin and Kingstown meeting (p. 300,) eminent for its maintenance of low fares, a motion for increased accommodation was similarly

brought forward and dropped. At the Greenwich meeting (p. 602,) some able remarks on the reduction of fares were made by the late resident director, Mr. George Walter, and a long debate ensued. At the Grand Junction meeting, a sound and sensible speech was made by the retiring chairman, Mr. Moss, (p. 698,) on the subject of low fares. At the Sheffield and Manchester meeting (p. 735,) Mr. Jackson advocated accommodation for third class passengers. It was at the North Midland meeting, however, that the grand debate of the year took place, on the speech of Mr. Vickers (p. 742,) and although the motion was lost, the opposition was evidently of a very moderate character. A proprietor of the Glasgow and Ayr meeting (p. 790,) expressed an opinion in favor of high fares, but the sense of the meeting was against him, and the meeting subsequently passed a resolution declaratory of their desire for a reduction of the fares on the joint line. At the South Western meeting (p. 754,) Mr. Chaplin delivered a masterly speech in defence of high fares which may be considered as the counterblast of that expiring cause against the opinions of Mr. Vickers. Discussions or questions were also raised at the meetings of the Great Western, Birmingham and Derby, and Blackwall companies. Thus the question of fares has come before the meetings of eleven companies.

We have now to sum up the names of the advocates who have this year declared themselves on either side. We therefore find among the advocates of low fares, Mr. Moss, late chairman of the Grand Junction (p.698,) Mr. Houldsworth, chairman of the Manchester and Leeds (pp. 237, 499,) Mr. Routh, chairman of the Blackwall, Mr. M'Call, chairman of the Glasgow and Ayr, Mr. W. A. Wilkinson, chairman of the Croydon, Mr. George Walter, late resident director of the Greenwich (pp. 446, 585, 602,) Capt. Lawes, superintendent of the Manchester and Leeds, (p. 239,) Mr. Bass, manager of the Glasgow and Greenock (p. 791,) Mr. Entwisle and Mr. Gill, directors of the Manchester and Leeds, Mr. Vickers, etc. Those who have stood forth in defence of high fares have been Mr. Chaplin, deputy chairman of the South Western (p. 754,) Mr. J. P. Maubert (p. 776,) Mr. Levi, the turnpike contractor, (p. 776,) and Mr. Henry Wheeler, director of the Greenwich (p. 604,) who cuts so ludicrous a figure in our pages!!!!!

One of the results of the agitation which is not the least curious, and another proof of the progress of low fares, is the recent formation of a third party, which adopts modified views, and which may be regarded as a weakening of the high fare party. This party may be considered to have declared itself at the North Midland meeting, (p. 742.) It was then put forward that high fares are to be preferred, but that low fares may be adopted as expediency may dictate. Among the adherents to this expediency party we may reckon Mr. Glyn, chairman of the London and Birmingham, and North Midland, (p. 742,) Mr. Hudson, chairman of the York and North Midland, (p. 743,) Capt. Porter, R. N. (p. 743,) Mr. M. A. Goldsmid, director of the Brighton and Greenwich (p. 602,) and Mr Robert Stephenson. Mr. George Stephenson expressed an opinion at the Birming-

ham and Derby meeting (p. 783,) against high tolls on mineral traffic, but we do not rightly understand whether he objected to high rates on mineral traffic on *canals only*.

[From the Civil Engineer and Architect's Journal.]

HISTORICAL SKETCH ON THE USE OF BRONZE IN WORKS OF ART. *By* CESAR DALY, *Architect.*

Some years ago, many, otherwise remarkable for their learning, would ask in what degree modern civilization differed from that of ancient Greece or Rome; and even in the present day, there are some who will ask the same question, even in England, in the heart of London, or of Manchester, or of Birmingham, with a thick cloud of coal smoke from a hundred factories rolling in volumes over their heads. To these, a feature so extraordinary, unknown to the ancients, tells no tale, though it is one which marks most strongly the character of modern times, superior in its power over physical nature, and the great development it has given to the efforts of mechanical invention. So generally, indeed, is the industrial character of modern times unnoticed, that we have scarcely any accounts of the various branches of manufactures, or of the subject generally, although this practical history is one which has the greatest interest in relation to the human race. This history in all its ramifications, whether as to the tools employed or the materials upon which they are exercised, would open a wide field of research, capable of ample gratification, notwithstanding the manner in which the records are dispersed. Among the metals and their alloys known at an early period, none has been devoted to such important uses as bronze, to which we shall devote the present essay.

Had the art of metallurgy been better known in distant periods, and the use of iron and steel more prevalent at a former epoch, or even had copper been more extensively used, we should have remained ignorant of much of the material history of antiquity, for both of the former metals disappear under the influence of rust, and copper is also a sufferer from the action of damp. Thus, while in the Portici Museum the bronze articles are well preserved, those of copper have been more or less affected, and those of iron are scarcely recognizable.

Copper was known in the earliest times, and is mentioned by Moses; but the difficulty of working it with the hammer, and the high degree of heat requisite to melt it, greatly limited its use. It was fortunately not long before the properties of a mixture of copper and tin were discovered, a mixture with greater tenacity and resistance than copper alone, fusible at a lower temperature, and denser than the mean of its components. By this mixture was obtained a metal which readily flowed into every part of the mould, so as to take a correct impress of the pattern, while it was hard enough to wear well, was not brittle, and so far from being injured by oxidation, which only affected it slightly, it was preserved by it from the action of the atmosphere, taking the beautiful color which

is so much admired. The providential discovery of these properties doubtless gave a great impulse to the infant civilization of the early stages of society, affording at the same time a greater facility for manufacture united with great durability. Thus it came to be employed for arms and edge tools by all the nations of antiquity, whether Indians, Chinese, Egyptians and Hebrews, Greeks, Etruscans, Romans or Celts. In connection with them, indeed, it might be well said that for many long ages bronze was the iron of the ancients. The fine arts were not long in making use of it, and we find it ministering to the decoration of many of the most ancient monuments of Egypt. In Scripture we find that the Philistines, after the capture of Sampson, loaded him with chains of brass, and Josephus relates that Solomon employed Hiram of Tyre to make two columns of bronze richly decorated, eighteen cubits high, twelve cubits in circumference, and four inches in thickness, or four times as thick as that on the Column of July. The columns were placed at the entrance of the porch of the Temple at Jerusalem. From these works, we may judge that working in copper and brass was already of old date at this distant period.

We are quite in the dark as to the processes of melting and forms of the furnaces used by the ancients; but we can readily judge, from the interest, in these days of the progress of science, still attached to the castings of bronze on a large scale, of the difficulties to which workmen must have been subjected in the rude state of chemistry and metallurgy. In Greece the use of bronze was very common; the Chalciæcos, at Lacedemon, was a temple of bronze, dedicated to Minerva, and executed about 750 years before the Christian era by the celebrated Gitiadas, poet, sculptor, and architect. Every part of this building, from the top to the bases of the columns, was entirely covered with plates of bronze decorated with mythological sculptures. Pausanias (B. 10, ch. 5,) relates that when the temple of Apollo at Delphi was rebuilt for the third time, it was constructed of copper, which is not surprising, adds he, as Acrisius had a bronze room made for his daughter, and as there is still to be seen at Sparta, the temple of Minerva Chalciæces. He goes on further to say, "at Rome, the place in which justice is administered excites surprise by its grandeur and magnificence; but what is most admired is a bronze ceiling, which extends from one side to the other. The same author, who attributes to Theodosius and Racos of Samos, the discovery of founding statues in bronze, informs us that it was about the year 600 before our era, that this art was first practised. This, like all the other arts, made great progress in the time of Pericles, but did not reach its full height until the age of Alexander, when each of the principal cities of Greece possessed several thousand figures of bronze, among which were some enormous colossi. This is what Pliny says in his 24th book, sec. 18, "There are numberless instance of boldness in this art, for we see that enormous colossal masses have been executed as large as towers. Such is the Apollo of the Capitol, brought from Apollonia, a city of Pontus, by M. Lucullus; this is thirty cubits high, and cost fifty talents. Such is the Jupiter of the Campus

Martius, consecrated by the Emperor Claudius, and called Pompeian, because it is near Pompey's Theatre; such is that of Tarentum, executed by Lysippus, and which is forty cubits in height. What is most remarkable as to this figure is, that it is so well balanced that it may be moved by the hand, although it could not be upset by a whirlwind. The most admired of these colossi was that of the Sun at Rhodes, made by Chares of Lindus, a pupil of Lysippus. This figure was seventy cubits high, was overturned 56 years after its completion by an earthquake; but cast down as it is, it still excites admiration. Very few men can put their arms round the thumb, the fingers are bigger than most statues, and the hollows in the broken limbs are like the yawning mouths of caves; inside are seen stones of large size, which were used to settle it on its base. It is said to have been finished in twelve years, and to have cost three hundred talents, a sum produced by the warlike engines of King Demetrius, when he raised the siege of Rhodes. In the city are a hundred other smaller colossi, each of which would be worthy of bestowing distinction on the town in which it might be placed; besides these are five colossi of gods by Bryaxis. Italy has also produced colossi, for we see in the library of the temple of Augustus, the Tuscan Apollo, which is fifty feet high from the toe, and in which it is difficult to tell which to admire most, the bronze or the beauty of the workmanship. Spurius Carvilius had a Jupiter made for the Capitol out of the helmets, cuirasses and greaves of the conquered Samnites. The size of this statue is such that it may be seen from the place in which is the Latial Jupiter. But in our times, Zenodorus has surpassed all the figures of this kind in height, in the Mercury which he made for a city of the Gauls in Auvergne. This was ten years in execution, and cost four hundred thousand sisterces."

It is probable that these colossi were formed of a number of pieces secured with nails, like so much brazier's work, for it is thus that the ancients made their metal statues before they had acquired the art of founding. At Lillebonne in Normandy, a few years ago, in the course of the excavations for uncovering the Roman theatre, a bronze Mercury was found made in this manner. In reading the travels of Pausanias in Greece, we cannot but feel surprised at the immense number of bronze works in sculpture which he meets with at every step, particularly when we recollect that this country has been in the possession of the Romans for three centuries, and that they had already, on several occasions, carried away thousands of bronze figures. Of 33 colossi described by the tourist, 30 were of bronze, the three others of wood; he also describes 32 equestrian statues of bronze and 24 chariots, at least of natural size, sometimes with two, and oftener with four horses, and holding one or two figures. Some were accompanied by runners or grouped with men on foot who led them; in fine, he mentions more than 40 animals of considerable size, also of bronze. And yet Pausanias only visited a part of Greece. It was of bronze that the Athenians, after the death of Pisistratus, formed the first quadriga, in memory of their fellow countrymen who died while fighting for their native land.

Of bronze also is constructed, in our days, the Monument of July. Bronze is, in truth, the symbol of strength, and it is interesting to observe how the same metal has been chosen, at two periods so remote, to consecrate the remembrance of facts having so much resemblance.

The Romans, as we have seen from extracts before given, made frequent use of bronze, and like the Greeks, employed in the form of candelabræ, lamps, furniture, triclinia, altars, tripods, tools, fastenings, letters for monumental inscriptions, window fastenings, etc. The doors were sometimes plated with bronze, secured with nails of the same metal; such as those of the Pantheon. Pliny (B. 34, § 7,) says that the ancients were accustomed to make the threshold and gates of the temples of bronze. Ancient gates entirely formed of bronze are still to be seen in the church of St. Cosmo and St. Damian in the Forum at Rome, formerly the temple of Romulus and Remus, and this luxury was not exclusively confined to temples, for 380 years before our era, the ornaments were of bronze on the doors of the house of Camillus. By means of cramps, large masses of bronze ornaments and carvings were fastened on monuments by way of decoration. On bronze tablets were engraved laws, treaties of peace, and public acts intended to be made known to posterity. Three thousand of these tablets were destroyed in the fire of the Capitol, in the time of Vespasian. Capitals were also made of bronze, which were secured on cores of stone. Pliny relates that "C. Octavius, who conquered Perseus in a naval action, erected, in honor of his triumph, a double portico, which was called Corinthian because the capitals of the columns were of bronze; this portico was near the Flaminian Circus; the capitals of the Pantheon, placed there by Agrippa, are of the same metal." The Romans further applied bronze in the execution of works on a large scale; the framing of the Pantheon was constructed of bronze, and, according to Serlio, who had examined it in its place, the different pieces were hollow; they were put together in the same way as woodwork. The caissons of the vault of this monument were also of bronze, and the circle which frames the opening by which the rotunda is lighted, still remains. In the baths of Caracalla the ceiling of the immense hall known as the Cella Solearis was formed of a net-work of bronze; a fact of which M. Blouet did not seem to be aware when he published his restoration of that monument. The ancients also constructed roofing of bronze, for at Rome, 212 years before the Christian era, the temple of Vesta, at Rome, was covered with tiles of bronze, and so, at a later period, was the Pantheon. As to bronze statues, there was at Rome a number truly prodigious, brought from all the great cities of Etruria, Greece, Sicily, and Asia Minor. Scaurus having erected a temporary theatre at Rome, towards the end of the republic, decorated it with three thousand of these statues.

The art of the founder naturally underwent all the vicissitudes of the other arts; in the time of Nero, the decadence had already commenced, it not being possible to cast the colossal statue of that emperor, modelled by Zenodorus, and which was to have been 110

feet high, although a century afterwards the beautiful equestrian statue of Marcus Aurelius was cast. Falconnet, in comparing these two facts, endeavors to make out a case for an attack on Pliny; but it seems to us that the circumstances may be reconciled by supposing that casting in bronze had been momentarily neglected before the time of Zenodorus, and that they had been more successfully cultivated in the time of Marcus Aurelius, for a similar circumstance happened in our own days. The brothers Keller, under Louis XIV., carried the art of casting in bronze to a high degree of perfection; but under Louis XV., the founders were not so good; and in the early part of the empire, great difficulties were met with in executing works of this kind, while now the art of casting in bronze has made greater progress than ever. Besides, it may be said that whenever a process is not carried on scientifically, while the reason of the different phenomena has not been discovered, and the artist consequently is reduced to take the bare results of experience for his guide, the neglect of the art for some time is enough to cause the facts to be forgotten, and the guides are consequently lost. This, however, cannot happen when the theory of an art is firmly based on scientific principles, and the reason of the phenomena is consequently understood; drawing our conclusions, from which we may say that the art of casting in bronze will henceforward never be lost, even should it be neglected for centuries; a few trials would be enough to bring it back to the point at which it had been left.

In the Middle Ages.

During the Lower Empire, nothing remarkable was executed, except some bronze gates, and the process of casting seems to have been quite lost at Constantinople. The gates of the Basilica of St. Paul, at Rome, were cast in the 11th century by Staurachios Tychitos of the Isle of Chios. In the 11th century were cast those of the basilica of St. Zeno, at Verona, on which are represented passages of the Old Testament and the miracles of the Saint. The bronze gates of St. Mark, at Venice, were also brought from Constantinople in the 13th century.

Germany possesses some bronze gates of the 11th century, such as those of Mentz and Augsburg. In 1330, Andrea Ugolino executed two panels for gates in bronze, from the designs of Giotto, for the Baptistry of Florence. Ghiberti finished his chef d'œuvre in 1424. In the 15th and 16th centuries several gates of bronze were cast at Venice, Padua, Bologna, Florence, Pisa, Loretto, etc.; but these works were not sufficient to prevent the art of casting in bronze from falling into complete oblivion, and during almost the whole of the middle ages this art was wholly limited to casting bells.

In Modern Times.

At the Revival appeared several bronze works of art, in which Italian artists, and particularly those of the famous school of Florence, in the beginning of the 16th century, distinguished themselves most, and contributed most efficaciously in diffusing a taste for it

in different European countries. The sculptor Torrigiani passed several years in England, where Henry VIII. gave him several commissions for bronze works. Primaticcio also executed, at Fontainbleau, several bronze statues from antique models which he had brought from Rome. At this time there were several French artists who were employed in brass founding; but their modes of proceeding seem to have been very imperfect, for Benvenuto Cellino relates in his memoirs that during his stay in France, he wished to cast a bronze statue of Jupiter about six feet high, which had been ordered of him by Francis I., "but never having been engaged in this kind of work," said he, "I consulted some of the old masters of Paris, and explained to them how we managed in Italy. They replied that their manner was different, and that if I would leave it to them, they were sure to make my model in bronze such as it was in clay. I made my bargain with them; I promised them the price they asked, and even something over. I put my hand to work, but I could see well enough that they were not trying the right way. I wanted also to try myself upon a head of Julius Cæsar, larger than life, made after the model of a small head designed from a beautiful antique which I had brought from Rome. I added to it a head of the same size which I moddled from that of a beautiful girl in my service, and whom I called Fontainbleau, from the name of His Majesty's favorite palace. When I saw my furnaces finished, and our models baked, I said to my master founders, I fear that the Jupiter will not come out well, because you have not left draught enough for the air; but they replied that, if they did not succeed, they would give me my money back again, and that I should find less chance of success in the Italian method. This took place before some gentlemen whom the king often sent to see how I was getting on. Before casting the melted metal for the Jupiter, the founders wanted also to place my two heads to cast them at the same time, feeling persuaded that their mode would not succeed, and that it would be a pity to lose such fine works; but the king, who learnt it, sent to them to tell them that they must think of learning from their master, and not of teaching him. Then, smiling, they put their Jupiter in the pit, and I also arranged my two heads at the sides, and when the metal was ready, we left a free passage for it. Our moulds were quite filled, and we were all happy, I, with having succeeded in my way, and they in theirs. They asked me for something to drink, and I gave them plenty of refreshments; they then asked me to pay the sum I had promised them. You smile, said I to them, then, but I very much fear that you will cry soon; for I saw that more metal ran into the Jupiter than was wanted, and that is the reason that I shall not pay you until it is all right. These poor men felt that I was in the right, and went away without saying anything. They returned the next day very quietly to empty their pit, and began with the two heads, which were perfect; they then came to the Jupiter, which caused them to cry out, as I thought, for joy, and which made me run, but I found their faces like those of the soldiers who watched the tomb of Christ. You see, said I, what has happened

to you from not believing me; you would have reaped more profit and I more honor. Learn, then, to work, and not to laugh at what is said to you. They acknowledged their error, but they regretted their time and expenses, on account of their families, whom they had to keep, and for which they should be obliged to run into debt. Never mind that, said I, I will pay you as soon as the treasurer pays me; for I pitied them, because they had worked with a good heart." Further on, telling the story about his statue of Perseus, which was also cast in bronze, he says, "The model of the Medusa, made of clay, and well secured with iron, had already passed through the fire; I had already covered it with wax, and the bronze only was wanting. I had my furnace built directly; I took such good care, and the figure came out so clean, that my friends thought it was all done, like the French and German founders, who never finish their bronzes after they come out of the fire, being doubtless ignorant of the practice of the ancients, and many of the moderns, who finish off with a hammar and chisel." This remark of Benvenuto would lead us into the belief that the French and German bronzes contained a good deal of tin; for when the bronze contains a good deal of copper, its fusion requires a very high temperature, which vitrifies part of the sand of the mould, which, becoming attached to the figure in cooling, requires to be removed; on the other hand, a larger proportion of tin making the metal more fusible, this result was less to be feared. Benvenuto, not contented with having executed so many admirable works, left also a treatise on casting in bronze, which was long the best manual on the subject.

SEVENTH REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD.

ENGINEER DEPARTMENT, CENTRAL RAILROAD,
SAVANNAH, *November 1st*, 1841.

SIR: A year has elapsed since the date of my last report of the operations of this department, and the progress of the work committed to its management. The expectations which were at that time entertained, that the grading of the whole of the road not previously let, would soon be put under contract, were soon afterwards realized; a large number of proposals were received from very respectable men, which rendered it easy to make a selection of good contractors; the work was speedily commenced under very favorable prospects both to the contractors and the company; and although nearly the whole year has been marked by a constant succession of heavy rains, with much sickness on some parts of the line among the laborers, I have the pleasure to state that the grading of nearly half the distance at that time remaining to be done has been accomplished.

The bridging over the swamp of the Oconee river, from the above causes, is not so near completion as I hoped it would be by this time, about 4,000 feet in length of bridge work has been completed in a very satisfactory manner; a large portion of the stone has been placed on the spot for the piers and abutments of the main bridge

over the river, and contracts have been made for the supply of materials for the rapid progress of the work during the present season.

The heavy freshets of the past year have induced me to increase the opening for the passage of the river water, and it is now intended to extend the bridge work to about 11,000 feet, leaving less than a mile of embankment in the swamp.

The citizens of Macon have, by a vote in town meeting, expressed their opposition to our crossing the Ocmulgee river with the road, and in acquiescence in this expression of their will, a site has been selected, and the land purchased, for a terminating depot on the east side. Although I always have been, and still am persuaded that the interests of all parties would be best promoted by terminating the road on the west side of the river, I do not apprehend that any serious disadvantages to the company, will arise from the present arrangement, and as a large sum will be saved by avoiding the construction of a bridge, the result is the less to be regretted.

The road is now completed, a distance of 137 miles, and the grading done 170 miles, leaving a little more than 20 miles of grading to be done, containing short of 1,000,000 cubic yards of excavation and embankment. The total length of the road being 190 miles and 2822 feet.

A contract has been made on favorable terms for laying the superstructure from the Oconee to Macon, including the furnishing of all materials excepting iron. The iron already on hand and ordered, is sufficient to extend the track 174 miles, leaving 16 miles yet to be provided for.

The following table exhibits the proportion of curved and straight line throughout the whole road, with the different radii of the curves. Number of curves 109. Number of straight lines 110.

Length of radius.	No. of curves.	Aggregate distance.
2,000 feet	25	44,017 feet
2,100 "	4	9,802 "
2,300 "	2	3,943 "
2,500 "	5	8,138 "
3,000 "	13	20,788 "
3,500 "	6	13,781 "
4,000 "	12	25,683 "
4,500 "	2	4,980 "
5,900 "	15	45,729 "
7,000 "	2	3,656 "
8,000 "	5	15,312 "
10,000 "	8	28,100 "
15,000 "	5	21,916 "
16,000 "	1	7,139 "
20,000 "	1	8,374 "
30,900 "	2	6,920 "
150,000 "	1	26,500 "
	109	294,778 feet

Total length of curved line	55 miles and	4,378 feet
" " straight line	134 " "	3,724 "
Total distance,	189	2,822 feet

The maximum inclination of grade is 30 feet per mile. The grades of the road may be classed as follows:

	Miles.	Feet.
Level	26	1,750
Inclinations not over 5 feet per mile,	44	4,880
" from 5 to 10 feet per mile,	30	4,600
" " 10 to 15 " " "	17	4,240
" " 15 to 20 " " "	13	3,160
" " 20 to 25 " " "	9	3,880
" " 25 to 30 " " "	47	1,432
Total	190	2,822

The trains are now in regular daily operation to the Sandersville depot (Franklin) 135 miles from Savannah where ample accommodation are provided for the comfort of passengers, and storage of freight.

In our motive power department we have eight locomotive engines, all in good repair—6 passenger cars—4 baggage cars—50 eight-wheel transportation cars—10 platform cars, besides a large number of repair cars.

Our enterprize has within the past year been visited by one of those disasters which often cloud the prospects, and retard the progress and prosperity of public works of this character. The unprecedented rains which fell in March last, brought down such a deluge in our water courses, as to threaten for the time to overwhelm us in ruin—several miles of our road lying along the vallies of the Ogeechee and Williamson's swamp, were overflowed; and to the portion of the embankments which had been most recently made, great damage was done—many of the small bridges and culverts were swept away or injured, and a considerable portion of the superstructure removed from its place.

Measures were immediately taken to place as large a force on the work of repairing these damages, as could be worked to any advantage; and it was then confidently hoped that all the damages would be repaired, and such alterations and improvements made in the construction of the most exposed parts of the road, as to make it secure, therefore, by the first of August. Our expectations would have been realized if the season had not been most unfavorable to the prosecution of the work; a constant succession of freshets in small streams traversed by our road, retarded our operations, and the almost universal prevalence of fever among the men, rendered them unfit for duty, and made it almost impossible to employ others to supply their places; these causes have prolonged the period of the completion of the work to the present time, and have also increased its cost. The total amount of the repairs including such

alterations and improvements as have been made in many parts of the construction, is about $56,000.

The question will doubtless suggest itself to every one feeling any interest in the success of enterprise. "Is there the probability of of the frequent occurrence of these disastrous visitations?" In reply to this question, I will remark that the grades of the road where projected and established upon the assumption that the great freshet of 1796 commonly called the "Yazoo freshet," was the extreme of high water, and that if we provided against a similar flood. we shall be secure. No freshet for a period of 44 years has reached the same height in the rivers with which we come in contact; but the flood of March last, was in the Oconee (at the pointwhere we cross) the Ogeechee, and in Williamson's swamp creek, an average of at least *nine feet* higher than the "Yazoo." The measures we have taken for future security have, been the substituting of trestle work founded on piles for embankment at the points where the latter was washed away; raising the grades in several instances, and planting the embankments with "Bermuda grass." The works in the Oconee swamp did not receive the least injury from the freshet, and I feel the most entire confidence that that part of the road when finished, will be perfectly secure.

I do not pretend. that, should we have another flood equal to the one of the last of March, we should escape without injury; but I feel assured that the damage, even in that case, would be small, compared with the last; and I think we have nothing to fear, except from such extraordinary freshets. Scarcely a public work in the country has escaped during the past year, and many have suffered much more severely than ours. I have thus extended my remarks on this subject, for the reason that I am aware that it is a point on which the friends of our enterprize feel much solicitude.

Every day's experience gives additional assurance that the success of the undertaking, so far as regards its profitableness to the stockholders, and usefulness to the public, is concerned, is placed beyond a doubt. On the opening of the business season this fall, the merchandize on its way from the northern cities to the various points of its destination in the interior flowed in immense quantities to our depot, which for a considerable time was kept full to the roof, for the reason that wagons could not be obtained in sufficient numbers to transport it from the head of the road. The cotton crop is rather late this season, but large quantities are daily carried to the head and other points of our road, and from present indications, the business of the season will exhibit a cheering prospect to the stockholders. The receipts of the road for freight and passengers for the last twelve months, ending October 31st, amount to $106,145,81, although the business was almost entirely suspended by the effects of the March freshet, for more than half the year.

There has, during the past year, been a great deal of discussion upon the subject of the rates of freight and passage on the road. It has been contended that a reduction of them would have the effect of increasing the amount of business sufficiently to yield a greater revenue to the road—the fact that this has been the effect of reduction on the English roads, and some of those of the eastern States,

is assumed as conclusive evidence of the applicability of the principle to ours, without for a moment considering the difference of circumstances. In relation to passengers, we have the benefit of an experiment recently made on a neighboring road, which shows conclusively the error of the advocates of lower fares in this section of the country. The president of the South Carolina railroad, in his last report, says, that the receipts of the company have been lessened $25,000 by making the experiment of reducing fares.

In regard to charges on merchandize, the fact of our having had, during the business season, more freight than could be regularly transported away from the head of the road, and that we should have had still more if a sufficient number of wagons could have been obtained, proves that no advantage would have been derived from a reduction of the rates of up-freight. The freight on cotton is less in proportion to weight and bulk than other goods, and less than one half the ordinary wagon rates. It is not contended that we have as yet arrived at the precise point in the arrangement of our tariff of freights, that no amendment or improvement can ever be made, but, while we are yet far from the completion of the road, and while there are so many circumstances bearing on the question, which will be entirely changed when we reach our final terminus, it is believed by those who have the control of the matter, that the interest of the company would not be promoted by a reduction, and this conclusion is the result of much study of the subject.

The probable period of the completion of the road is a subject of frequent inquiry, and could readily be answered if the company had in hand a sum of money sufficient to cover the cost of the remainder of the work and materials; but, as nearly all the contracts now in progress, provide that payment shall be made in the bonds of the company, the contractors cannot be pushed with the same spirit, as if they were receiving ready money for their work.

Application will be made to the legislature for the extension of the time allowed for completion; not from any apprehension (so far as present prospects indicate) that the road will not be finished within the time prescribed by the charter, but to provide against unforseen contingencies.

The experience of the last year confirms my previous opinion, that the business of *freighting* is to be relied on mainly to support the road, and will constitute by far the greatest proportion of its earnings; although our passengers must of course increase greatly whenever we cross the Oconee river.

I am sir, very respectfully,
Your obedient servant,
L. O. Reynolds, *Chief Engineer.*

W. W. Gordon Esq., *President.*

[From the Railway Magazine.]

MANUFACTURE OF IRON FOR RAILWAYS.

A considerable portion of the evil arises from the fact, that, with some very few exceptions, neither the directors, nor the engineers of

railways, are practically acquainted with the manufacture of iron, and are therefore not aware of the immense difference which exists in the quality. The price of railway axles (in their rough state) varies from £12 per ton to £25 per ton. The price of wrought iron wheels is just double the price of cast iron; in chairs, the price varies as much as forty shillings per ton; and in rails, there is a difference of from thirty to forty shillings per ton between different manufactures; and this too in an article where from the enormous quantity used, the cost of production is calculated by the manufacturer with the greatest nicety. Now whence arises all this difference? Entirely in the quality of the articles themselves, and not in the amount of profit which different manufacturers consider themselves entitled to, nor in the difference in the expense of carriage from different parts of the country. For, by a strange anomaly, the lowest priced articles come from those quarters from whence the carriage is generally the most expensive.

One great evil attendant on the employment of iron of inferior quality, arises from the circumstance, that iron exposed to great and sudden changes of temperature, and to a constant percussive action, is liable to a slow and gradual change, arising from a re-arrangement of the particles among each other. Although this may appear too theoretical for some, it is still capable of proof by direct experiments in particular and extreme cases. The two great distinguishing features of wrought iron are known by the names of "cold short iron," and "red short iron," the former being the toughest when hot, and the latter when cold. The cause of this great difference is still involved in mystery. It has been attributed to a minute quantity of arsenic in the former description of iron, which is not present in the latter. But this may well admit of considerable doubt, for by heating red short iron a few times, and suddenly quenching it with water, or by a longer continued process of heating without this sudden cooling process—as for instance in the case of wrought iron furnace bars—the most fibrous and toughest red short iron, becomes converted into the most brittle cold short iron, the fibrous appearance being exchanged for that peculiar crystallized arrangement of the particles, which so distinctly marks the cold short quality. By what process this crystallization takes place is wholly unknown: but many similar facts in natural philosophy would lead us to suppose, that the effects of sudden changes of temperature, under peculiar circumstances merely cause the particles of matter to approach or recede from each other, to that particular distance which allows of a new arrangement of the atoms among each other. The instantanious formation of ice, when water is cooled several degrees below the freezing point and a sudden vibration is communicated to it by a blow given to the vessel containing it, is a familiar instance of this kind of effect, arising from a new polar arrangement among the particles when, by change of temperature or some other cause, they are brought within a particular distance of each other. As regards this crystallization of wrought iron, there are many facts which seem to lead to the conclusion, that iron continually exposed to minute vibrations, slow-

ly changes to that state of crystallization which can be more rapidly affected by the agency of high degrees of temperature; and if this be the case, we have in constant operation, in many instances, a process which is continually tending to weaken the cohesive strength of iron, and which will more readily take place in iron which partakes in any degree of the cold short character. This, I think, will scarcely be doubted, if we may at all draw any analogy with the process of the congelation of water already alluded to. When water has been cooled several degrees below the freezing point, a sudden blow given to the vessel will generally, but not always, cause its instant congelation. But if the smallest possible particle of ice be put into the water, the crystallization of the whole mass will *always* be instantaneous. We may imagine, therefore, if any similarity exists between the two cases, that iron possessing *a tendency* to the cold short quality will, when subject to the constant state of vibration to which it is exposed on railways, more rapidly deteriorate than red short iron, and become more crystalline in its texture, and therefore possess less cohesive strength.

But whatever may be the tendency to deterioration, there is far too little attention paid to procuring, in the first instance, iron which has been manufactured by processes likely to secure an approved quality. I need scarcely say, to those acquainted with the subject, that railway axles cannot be made of faggotted iron (which I consider indispensable for this purpose) for the low price at which they are charged by some manufactures, and therefore inferior materials are always substituted. I shall, however, pass over this, and confine my remaining observations to the manufacture of railway bars and chairs.

The iron masters have for many years been trying to avoid the process of refining the metal which is used for remanufacturing at the forge. As far as mechanical structure, and even chemical examination goes, the process of refining appears merely to reduce the better qualities of pig iron to the same state as the common "white iron" produced by the furnace. But experience proves that the one cannot be substituted for the other without a very great deterioration of quality in the manufactured bars. Many years of continued experiment have fully proved this, and it matters not, that no rational explanation can be given why the one will not answer the purpose of the other. All parties are agreed that "refining" is necessary to produce really good iron, and that no addition to the subsequent operation of "puddling" can compensate for neglecting it. But the saving of expense is considerable by this mode; and hence the Staffordshire iron masters are now very generally adopting the plan of omitting the refining process in the manufacture of rails, to enable them to compete with the Welsh manufacturers, who it is supposed, can make iron cheaper than their English competitors. The processes which all pig iron ought to undergo, in order to convert it into bars, are, refining, puddling, shingling, rolling, piling, balling, and re-rolling. This makes common, or No. 2 bars, which, when cut up and again heated, are rolled into rails. Now nothing *less* than this process ought ever to be employed for rails,

and several manufacturers increase these processes in different ways, some by an additional hammering, and others by an additional heating and rolling, before rolling the iron into rails. But some also there are, who considerably *reduce* these processes in the following manner:—They leave out *both* the fining and the shingling, substituting for the former a trifling addition to the time the metal remains in the puddling furnace, and for the latter, or shingling process, they give the blooms a "nobling," as it is technically called, which puts the iron into a little better shape for the rolls, but adds nothing to its quality, as when the shingling hammer is used. Some manufacturers still further reduce these operations, by using a portion of No. 1 bars, which have only passed once through the rolls. Now the result of all this is, that the finished rails, instead of being of a tough fibrous texture, are only one remove from cast iron in quality. The bars, if broken, will present a chrystaline appearance; and in strength they bear no comparison to iron which has been properly manufactured. This I consider to be a most serious matter. Thousands, nay, tens of thousands of tons of rails have been made, and are now making in this way, and the directors and the engineers are alike ignorant both of the practice and of the very serious results to which it may lead.

There are, however, other causes which deteriorate the quality of iron, not less than deficient processes of manufacture. The minerals of some districts are naturally so weak, that no art or care in the manufacture can render the iron made from them sufficiently strong for any description of railway work. I am unwilling to enter into particular descriptions, which might appear invidious, or which might seem the result of personal interest. Neither of these sentiments, however, influence me, as I have no interest whatever in the question, nor any motive beyond that of making known a matter of what I consider of great public importance.

But if the question of the strength of the minerals, from which the iron has been made, is a matter of importance in the case of rails, where, according to the general plan at present in use, the rails are made so exceeding strong, for the purpose of resisting deflection, that they may be considered comparatively free from the liability to actual fracture, it becomes of double importance in the case of railway chairs, which are constantly liable to fracture from the very nature of the materials of which they are made, as well as their form and the position they occupy. The very general introduction of the hot blast has tended much to deteriorate the strength of pig iron. I consider cold blast iron ought alone to be used in the manufacture of railway chairs; and not only so, but that the strongest description of cold blast pig iron, ought to be allowed to enter into their composition. Instead of this being generally the case, the greatest rubbish, provided only that it possesses the general characteristics of iron, is frequently used for this purpose. The very worst description of old iron, so bad as to be unfit for any other purpose, is purchased expressly for mixing with other iron to make railway chairs; and the only wonder is, not that such chairs should frequently break, but that they should ever stand the required strain. Others

there are who mix the pig iron with the commonest description of hot blast iron; and others—and they too among the largest manufacturers, cast the chairs direct from the furnace, instead of making them from pig iron of the second fusion. Now all these practises, while they tend to reduce the cost of the chairs, are, I contend, dangerous in the extreme; and no saving which can be effected by these means ought for a moment to be put in comparison of the danger which must result from the use of inferior iron either in the rails or chairs.

[From the Troy Whig.]

CATARACT OF TAQUENDAMA, IN SOUTH AMERICA, COMPARED WITH THE WALLED BANKS OF THE AU SABLE RIVER, THREE MILES FROM PORT KENT, ON LAKE CHAMPLAIN.

SARATOGA SPRINGS, *August* 29, 1840.

These two objects, the most singular and wonderful display of Almighty power in this world, just begin to be known to the North American public, although the former has for ages been considered and visited by the South Americans as the greatest natural curiosity in that country. Having noticed in a late Troy paper a short but interesting description of the Walled Banks of the Au Sable, inviting further disclosure and a more minute description; and having lately made an excursion to that place, with the celebrated Colonel Duane's description and map of the Cataract of Taquendama in hand, I was astonished to find so close a resemblance in their general features; but finding myself inadequate to afford a just description of either, I will avail myself of the classic pen of the Colonel, in his visit to the cataract with Colonel Todd, who made up a party of pleasure, mostly of Americans, at the city of Bogota, in Colombia, for the excursion. He says:

"No painter can convey any adequate idea of this extraordinary work of nature. None of the descriptions I had read of this cataract conveyed to my perceptions any thing like what it is. I placed myself on my breast to contemplate this wonderful display of Almighty power, with my head only over the side, while Lieutenant Bache stood on the verge, with folded arms, surveying the abyss below with perfect composure. The mind is beguiled in the intensity of admiration and awful sublimity of the spectacle, which in every aspect presents new beauties and astonishments.

"Imagine a lane, if I may so call it, three-fourths of a mile long, with perpenticular and parallel walls, about fifty feet apart and one hundred and seventy-nine feet high, as uniformly fair on their faces as the best masonry at the Capitol, which will always induce the astonished spectator to ask if these walls be not the work of art, constructed with the chisel, the trowel, the level, and plumb line! The elevation of the side walls—their parallel length of three-fourths of a mile—could be but imperfectly expressed by the pencil on canvass. The reader must therefore, from the data, figure to himself

some conception of this extraordinary work of the Great Architect of the Universe."

In reference to the Walled Banks of the Au Sable, it is impossible that a more correct view can be given than by Colonel Duane's description of the Cataract of Taquendama—the length, the relative distance of the walls, the *workmanship*, all compare with such wonderful precision, with the exception that the cataract receives the entire river at its summit, whereas the Au Sable enters the Walled Banks at its base.

No person can contemplate either of these wonders but with solemnity and awe, in a profound belief that both are the works of the Divine Architect of the Universe, and works which will in process of time be visited by millions upon millions, through all ages, to the end of time, with sublime admiration. All who have visited both the Falls of Niagara and the Walled Banks do not hesitate to say that the latter is by far the most interesting as a natural curiosity—the Falls having originated from natural causes, from a combination of vast inland oceans seeking the Atlantic.

A Visiter.

Walled Banks of the Au Sable.

This wonderful display of Almighty power at creation, is situated about three miles from Port Kent, on Lake Champlain, and is one of the most interesting natural curiosities on the globe, with the exception of the celebrated Cataract of Taquendama, in South America, both of which nearly correspond in their general features. As no just idea can be formed by any, of either, short of a personal examination, I dare not attempt it, but leave that to the pen of a poet and to the pencil of a painter. As the curiosity of the public is strongly excited and greatly increased within a few weeks, in consequence of the passage of the Port Kent and Ogdensburg railroad, crossing, near the celebrated high bridge, nearly two hundred feet above the river, our readers and the travelling public are notified that a trip is easily made from here to the Walled Banks by the way of Whitehall, where you can embark daily, at ten o'clock, on board an elegant steamboat, and arrived at Port Kent in the evening.

The ensuing morning you cross the Au Sable river, at the village of Birmingham, three miles from Port Kent: the bridge passes over rocks piled on rocks, the river dashing in the midst, descending one hundred feet at their base, proceeding about half a mile in a direct course to the entrance of the walled banks, which runs in two parallel lines from 40 to 60 feet apart, nearly in a direct line for a mile in distance, and about 150 feet deep. What will forever astonish the eyes of every beholder is, these perpendicular banks in their whole extent were constructed by the Great Architect of the Universe, to all appearance, as if by the hands of masons, with hewn stones in uniform lines, the seams neatly pointed. About half a mile beyond Birmingham, on the Keeseville road, you pass at the edge of Watson's falls, a perpendicular pitch of 60 feet of the entire river, thence to Keeseville, one and a half miles, you again

find the river precipitated to its destiny in the midst of the rocks and iron manufacturies. We hope soon to see a good description for public information.

[From the Mining Journal.]

ON THE MANUFACTURE OF IRON.

The principal difference between the metal contained in iron ores of various species consists in the metal, when in the shape of good cast iron, being either red short or cold short—that is, more brittle when red hot than when cold, or more brittle when cold than when hot: for the forge purposes, the red short is the best. The cold short quality is generally believed to be occasioned by a very minute quantity of phosphorus contained in the iron. By ascertaining this fact respecting ores, if necessary, the difficulty may be greatly obviated by mixing it with ores of the opposite quality, whereby, with proper management, the produce may be neutral. When the metal is intended for forge purposes, and required very tough, it should be ascertained whether the ore contains any manganese, and in what proportion, as nothing tends to render apparently very good iron more brittle than the presence to any amount of this metal. If it exceeds 1 or 1½ per cent., ore perfectly free should be mingled with it in various proportions—somewhere about half and half; nothing is better than either one of the hematites. The quantity of fuel and the quantity of flux required, in proportion to the ore, depends on the character of the ores; all argillaceous ores, which generally contain a little sulphur, should be calcined before they are thrown into the furnace; the general shape of these calciners is that of a lime kiln. A fire having been made at the bottom, the ironstone and small coal is thrown on in alternate strata, and the whole kindled; it is drawn out as it is thought to be calcined, faster or slower. This process greatly assists the smelting, inasmuch as a great quantity of earthy matter is got rid of, which could not be separated by hand; and also the metal in the ore, if an oxyde, is raised to a greater point of oxydation, and reduces more speedily in the furnace. The hematites, being in the state of the highest oxygenation, require not calcining, and if they are used alone, must be fluxed variously, as some contain argillaceous earth, others calcareous, and other silicious. Also, to obtain the best metal from them, charcoal should be used instead of coke, there being much less earthy matter in it; the earth of the coke is very apt to get into the iron, which renders it impure.

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The pig-iron is first melted in the back fire, which generally occupies about three quarters of an hour; the man keeps working it about with a bar till it is all melted; and if when he stirs about the bar and withdraws it, the metal on the point sparkles and scintilates, it is ready; the metal should never be let out till this is the case; if the next fire is not ready, the blast should be slackened, so as not to burn the iron, but still to keep it up to the proper pitch. The metal generally requires a little slag more than it produces by itself, and some thinner, as its own is thick and turgid. The cinder from the

lower fire is the best, as it is, when liquid, much thinner, and allows the metal to sink after being well worked. In working iron rather inferior in this fire—say, poor bright and low mottled—it may be a great deal improved by throwing in a shovel of broken limestone to each charge. This engages with the earthy impurities, and clears the iron a great deal, though it by no means makes it equal to that produced from better cast iron. During the operation some of the slag is tapped out by the hole under the fire plate, when it has accumulated to too great a quantity, which is apt to impede the blast.

When the lower fire is ready for receiving the metal, it is tapped from the back, and runs into the bed of the lower one, where it is received on a bed of charcoal dust, and, as it runs, the workman, with a bar, stirs it up; the fire is kept full of charcoal, or of coke, when making coke iron, in which case they generally use some of the small broken charcoal on the floor of the yard. This operation is conducted by the workman continually stirring up the iron, and raising it up to the stream of air—the oxygen of which soon deprives some of the iron of its carbon, which coagulates; and this process of decarbonization proceeds till all the iron is collected into one mass or ball; the small balls, which form at first, are continually raised to the top of the fuel, and then allowed to sink, with its combustion passing slowly before the blast, which generally blows holes through it, and completely frees it from carbon; the operation is considered finished when all the iron is coagulated into one ball and the cinder lies underneath it, which is taped out as it requires. The charge in a back fire is generally about 3 or 3½ cwt.; this, of course loses much in the two fires according to the nature and quality of the iron. The charge, when working on coke iron, is taken out in one lump to be hammered, but working charcoal, one lump is drawn about three quarters time, and the rest follow it, as small pieces are better refined in the fire and better hammered, than large ones. The only requisite in hammering is to do it regularly, so that all the stamp may be of the same texture, and also to hammer it thin enough. Coke should never be more than 1½ inch thick, and charcoal not more than one inch. When of these sizes, they heat much more regularly at the hollow fire than when thicker, as in that case, the outside surfaces are apt to burn before the mass is hot enough to weld well. After being hammered, the stamp is thrown into a large box of water, where a continual stream is running through; this assists the stamp in throwing off the scales of oxyded iron formed during the hammering, and what little cinder may still adhere to it. The appearance of a stamp, which has been well worked and properly hammered, is that of large open crystals; if this is intermixed with parts cutting much finer, either towards the edges or in the middle, it is a sure sign of its not having been sufficiently worked, or what the men term "raw," part of it having escaped the action of the blast, and therefore, still containing a proportion of carbon and earthy matter. If the men are careless in working it, the stamp sometimes throws a quantity of dirt in the middle or towards the edges; this must be thrown back by the stamp cutter, as one piece will spoil a whole bar. The stamps are now taken to the

hollow fires to be wrought into bars; they are piled on the end of staffs, in three layers; the middle layer here always consists of black plate shearings, bundled, which tends to keep the lump open and more accessible to the heat uniformly: where these cannot be obtained, the best thing is the cuttings off the ends of other bars; it also permits the cinder that may be attached to the surface to run or be blown out from between. The lump should never, when cut off after working, and rolled into a bar, weigh more than 100 lbs. as the men cannot possibly work a heavier piece well. The staff is then entered into the fire, and the heat continued, till it is throughout in a welding state; it should, then be drawn under the hammer, to weld it firmly; it should, before the heat is off, be hammered on on every side, to make it perfectly solid, but the first three or four blows should come on the flat, which renders the middle solid, and and drives out any cinder that may be between. As it is impossible to improve the body of a lump after the first or welding heat, great attention should be bestowed on it, that the iron is not burnt in the first place, and that it is not drawn out before it is quite ready in the next. To make the best bars, the iron should not be heated more than twice if possible, as every heating partly undoes what the preceding hammering has done; and the second, if required, the third, heat should be as low as possible, for the proper drawing of the bar. The lump should first be drawn into a piece about three inches thick, and 3 or 3½ feet long, then cut in the middle, and the end piece turned upside down, back on the staff piece; this reverses the fibres, and tends to strengthen the iron; and also brings all the waster piece to end. This operation, of course, requires a good welding heat in the second process, but the hammering should be completed in that, the bar drawn to the proper length, and cut off hot enough for rolls to receive it an once; if it must be heated again for passing it through the rolls, it must also be hammered: sometimes men, if not watched, pass it through without—the almost sure consequence of which is, the bar is spoiled. This process of cutting the lump and doubling it is not always practiced, but where the best and toughest iron is wanted, it should be done. The hamslow, or cinder, driven off with the hammering, is generally preserved for the furnace: when the hearth is at all foul, the addition of a little hamslow will generally work it off, as, being already an oxyde of iron, it works much hotter than raw mine. The bars are then sent up to the black plate mill, where they are cut into lengths, according to the sized plates wanted. The pieces are then piled on one another, (about 12 or 14) and placed in the furnace, which is a large reverberatory, having a small fireplace in proportion to the square of the furnace itself. Four or six of these piles are heated at once—the door and the top of the chimney being closed, so that all the heat being retained, the plates get a uniform heating. The rolling of these pieces, which vary according to the plates wanted, from ⅜ to ½ by 5 inches wide, is called breaking down. They are passed through the rolls a certain number of times, so that they come to nearly the same length, about two feet or so long. These first plates are then thrown, as they are rolled, into the same furnace again, on one side

upon one another, corresponding to the first pile; and, after all are in, the door is again closed, and they reheated. In breaking down, the pieces should be entered rather corner ways, as if the whole broadside is entered at once, the jar is likely, if not certain, to break the rolls. The first plates are then again rolled, which brings them about 4½ to 5 feet long; they are thrown over to the doubler, who doubles them up and flattens down the bend with a hammer; they are then thrown to the furnace man, and again heated and rolled. This process is continued according to the plates wanted—sometimes doubled twice, sometimes three times, and four times, which last makes it sixteen thicknesses. The plates, during the last rolling, are measured by a guage which the workman has for the length; he makes them as near to this length as possible, so that two or three, as they are wanted, may come out lengthways. They are then passed on to the shearers, who mark and cut them to the proper size; girls then divide them, and they are sent to the scaling furnace.

Western Trade.—The western trade of New York is about to assume a new channel. The railroad from Boston to Albany, direct, will be completed the entire distance in three weeks. Soon after that time, the navigation of the Hudson will become uncertain, and the boats will in part suspend their trips between the two cities. Heretofore a perfect embargo has been laid upon all business of a heavy nature, after the river closed. Thousands of barrels of flour and other articles of western produce have annually remained in the storehouses of Albany, from inability to reach the Atlantic market. This will no longer be the case. The moment navigation ceases, or before that time, the long trains of cars, led on through lofty mountains and over deep ravines, will be making their daily trips between Albany and Boston. In spite of wind or tide, sunshine or tempest, this daily communication will be kept up, and the produce of the vast west will find a ready and at all seasons an accessible market. This "iron river" will not be affected by droughts or floods, or the exigences of the seasons. It connects at Albany with a continuous railroad to Buffalo, thus uniting the "village of Boston" with the most fertile and extended portion of the western world. Boston, during the winter, will carry on an exclusive trade with that portion of the west with which New York has heretofore enjoyed the exclusive traffic. Her merchants will supply their wants, and in return she will except the products of western fertility as compensation. When trade once is diverted from old into new and successful channels, it is no easy matter to regain it. Between New York and Boston there will now be a rivalry for trade, which the "commercial emporium," with her strength and dimensions, has been accustomed to speak of vauntingly, as of no account—mere child's play. It will now require all her resources to be active, and her energies to be put forth with more than ordinary zeal, not merely to gain new business, but to retain her *accustomed trade.*—*Philadelphia North American.*